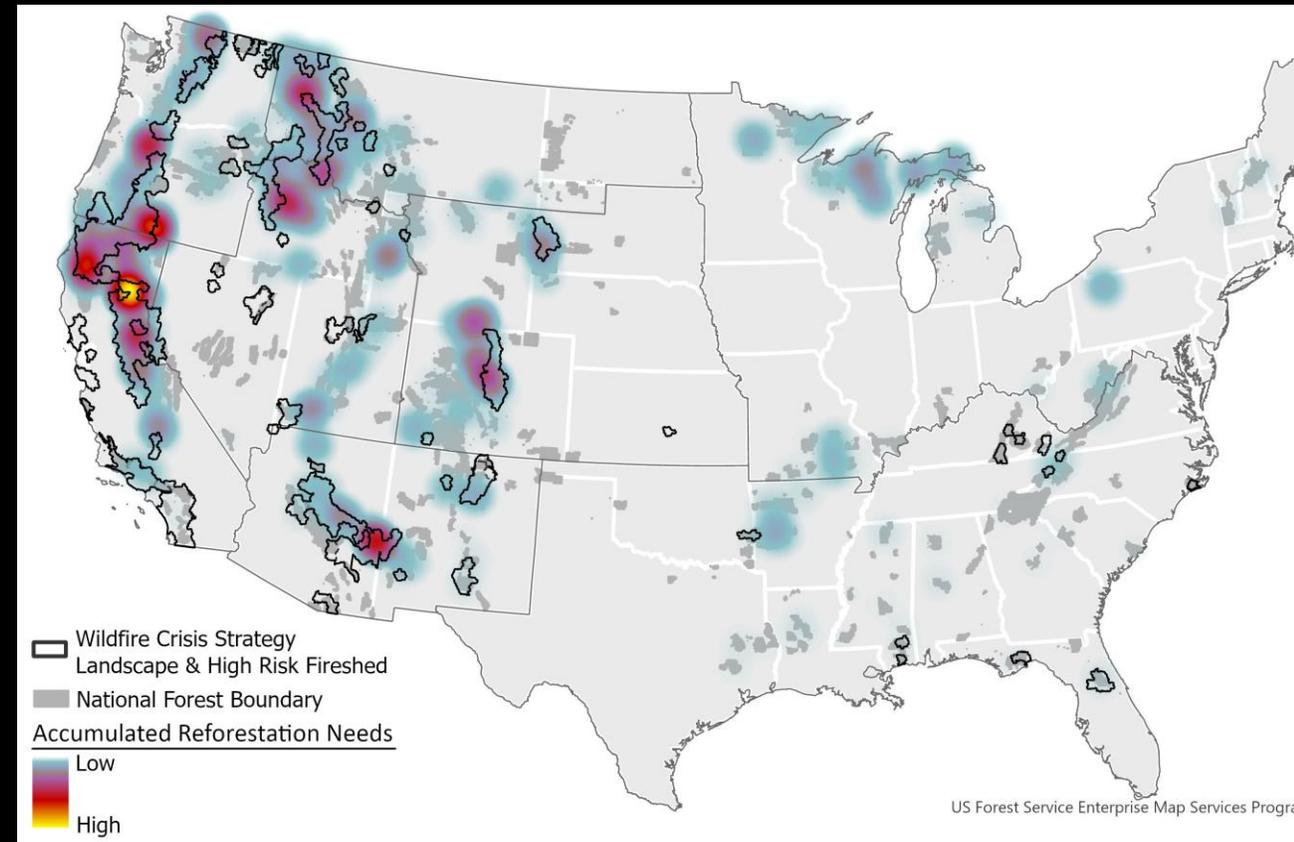
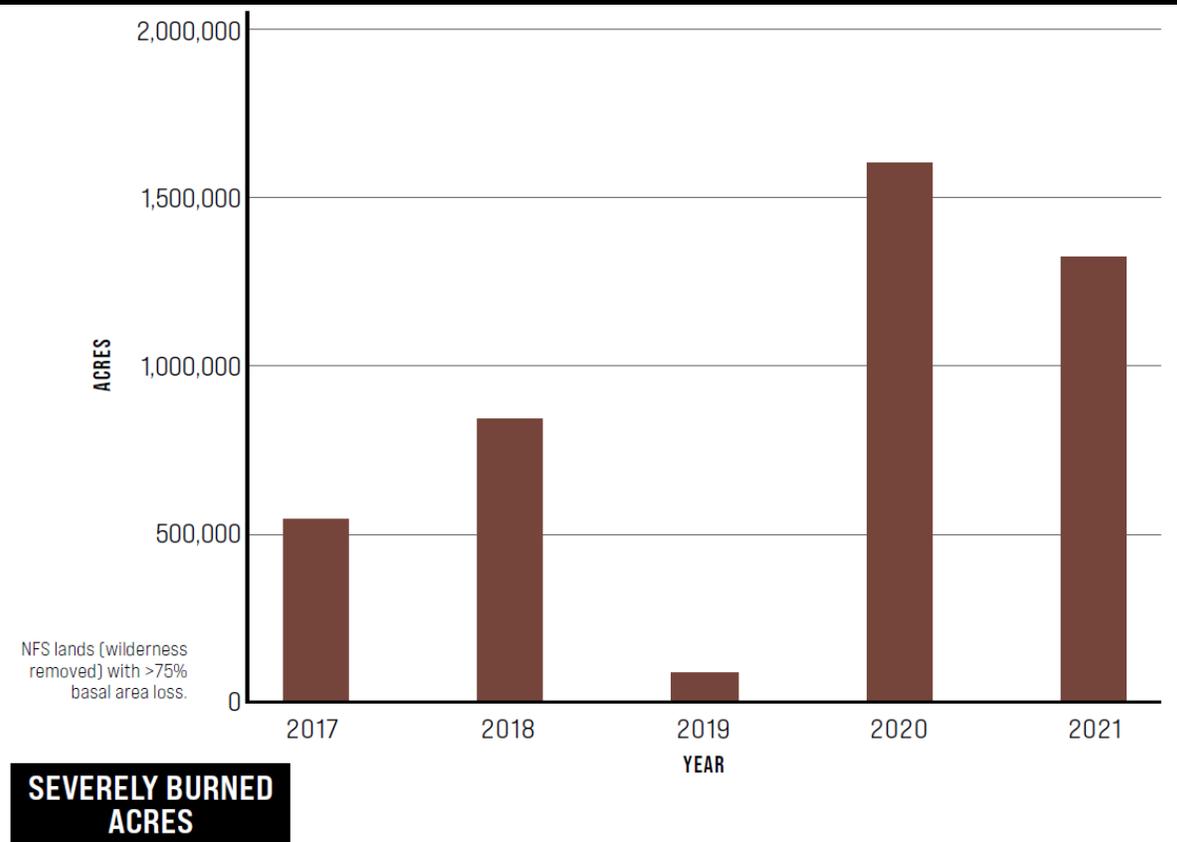


Using assisted migration as a climate adaptation strategy during reforestation

Rob Slesak, Research Forester - PNW Research Station



Reforestation needs are at a critical level



Opportunity to address climate adaptation

Adaptation Options

(ASCC, after Millar et al. 2007)

Manage for Persistence

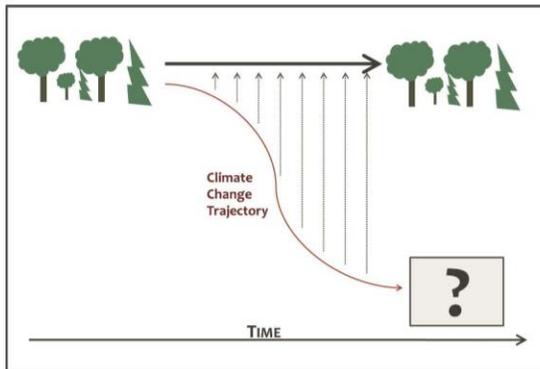
Ecosystems are still recognizable as being the same system (character)

Manage for Change

Ecosystems have fundamentally changed to something different

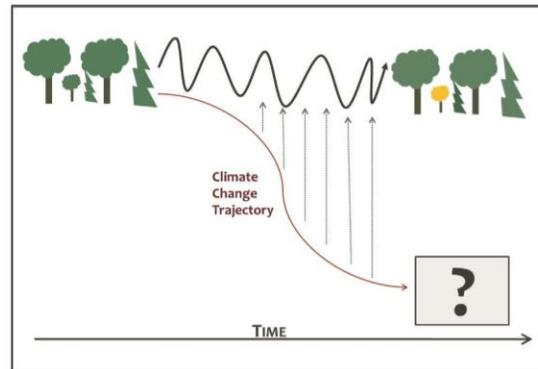


RESISTANCE



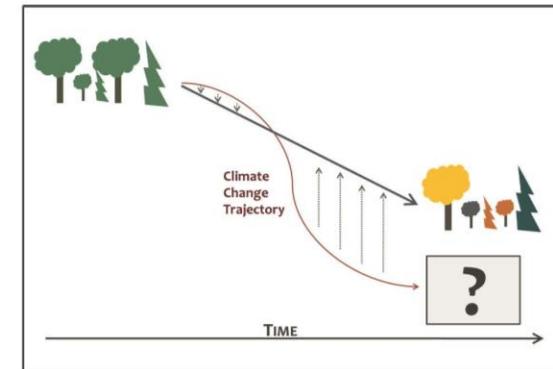
- Improve defenses of forest against change
- Maintain relatively unchanged conditions

RESILIENCE



- Accommodate some degree of change
- Return to prior condition after disturbance

TRANSITION



- Facilitate change
- Enable ecosystem to respond to new and changing conditions

What is reforestation success?

Two components:

1. Short term establishment

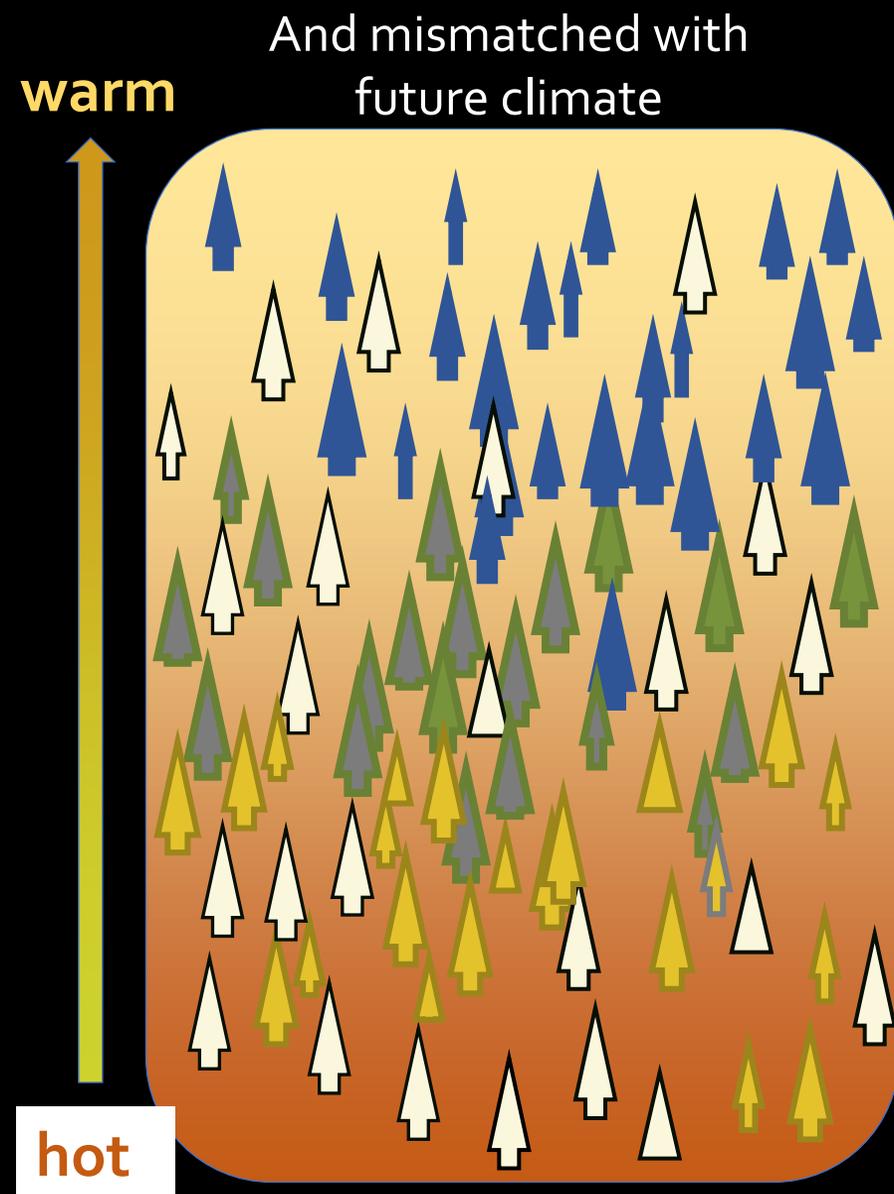
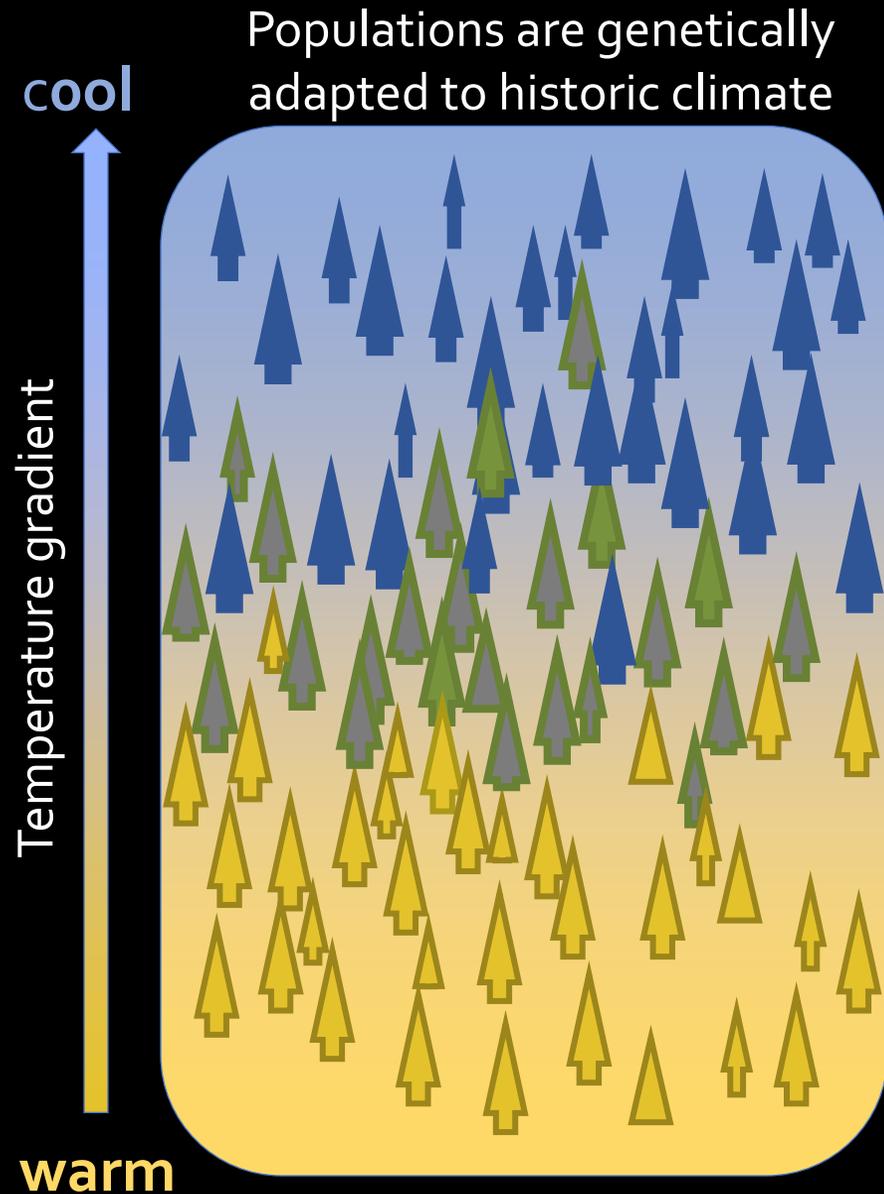
- Immediate threats to survival
- Achieving a minimum stocking level at “X” years

2. Long-term resilience

- Future-adapted species and genotypes
- Favorable stand conditions / structure



Species are increasingly maladapted to climate



In general,
trees are
adapted
to the
climate
where
they are
found



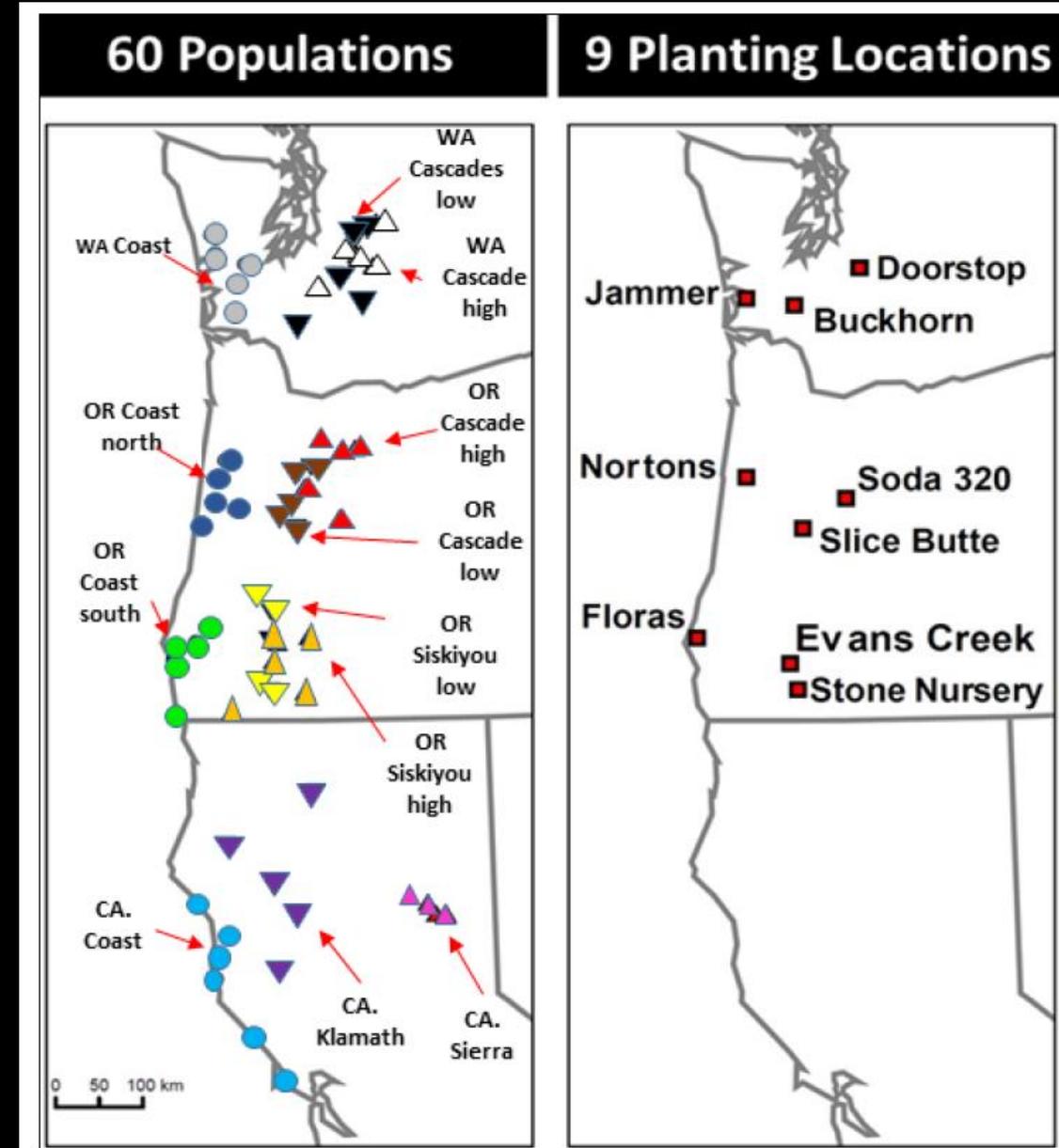
Lodgepole pine provenance trial, low elevation – British Columbia
Greg O'Neil, BC Forest Service

Seed Source Movement Trial

Objective: determine the effects of climate and genetics on survival, growth and performance of Douglas-fir

Treatments: 60 Douglas-fir populations (12 regions x 5 populations in each)

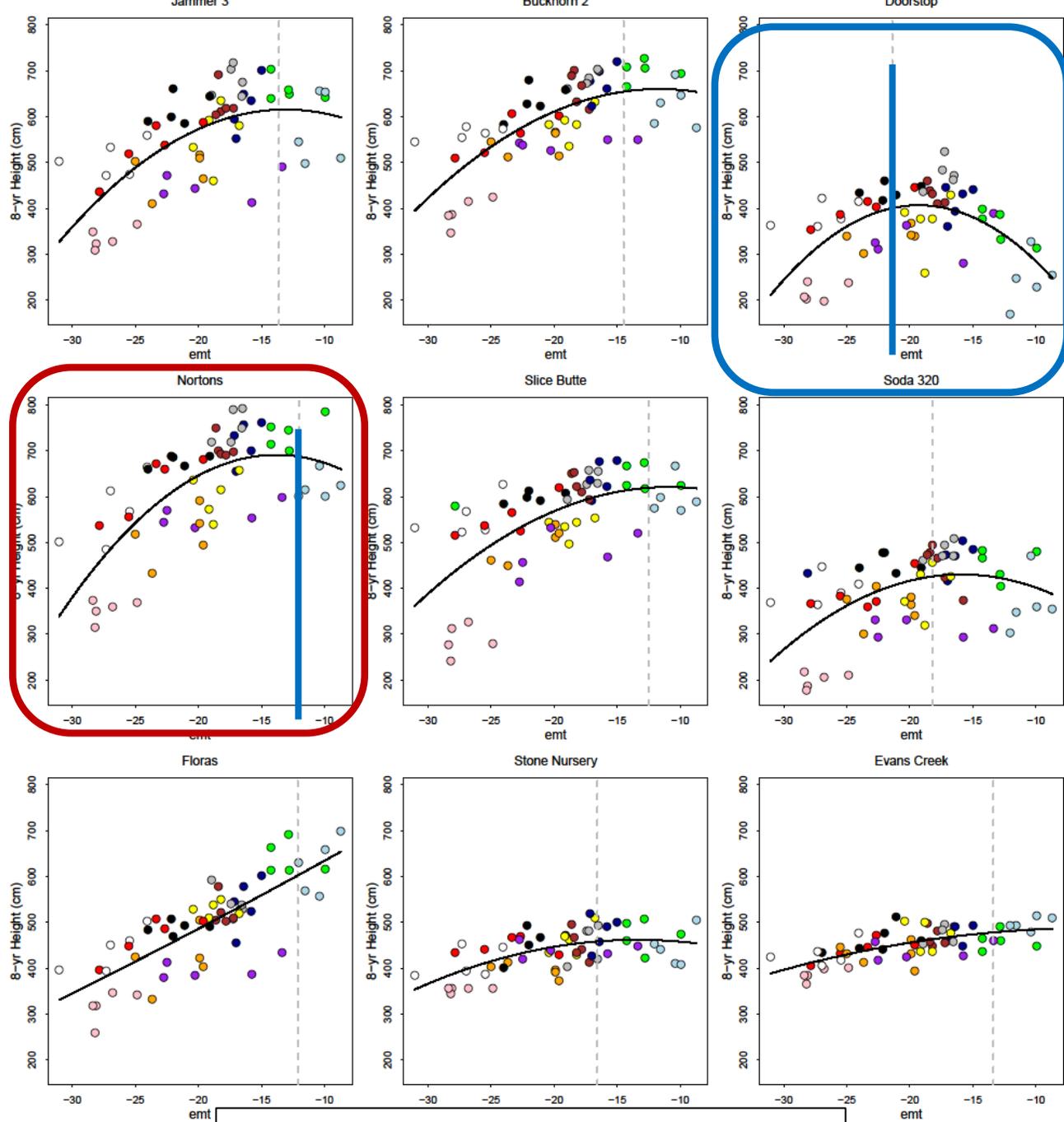
9 planting locations that span geographic and elevation gradients



Cascade Timber
Hancock Forest Res.
Port Blakely Tree Farms
Starker Forests
Washington DNR

Giustina Land & Timber
Lone Rock Timber Co.
Roseburg Resources
USFS Stone Nursery

8-year Height (cm)



Extreme Minimum Temperature (°C)

Populations are locally adapted:
 at all sites, sources from climates
 similar to the test site are among
 the tallest

- CACST
- CAKLA
- CASIERRA
- ORCASH
- ORCASL
- ORCSTN
- ORCSTS
- ORSISH
- ORSISL
- WACASH
- WACASL
- WACST

Nortons Test Site:
 Warm, coastal site
 EMT = -12 °C

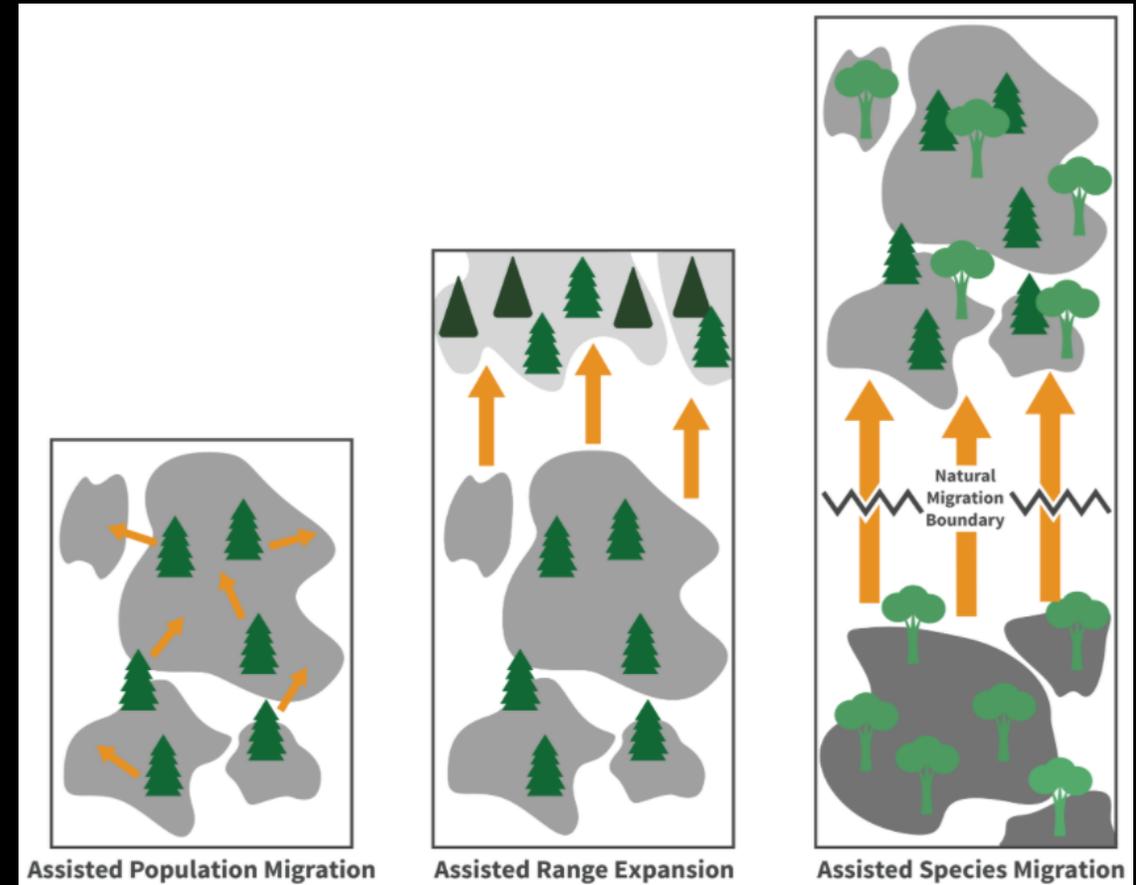
Doorstop Test Site:
 Cold, montane site
 EMT = -21 °C

What to plant - assisted migration

Population migration – movement of seed sources to new locations within an existing range

Range expansion – movement of populations just outside their range

Species migration – movement outside the range, farther than naturally possible



Population

Range

Species

Increasing risk of impact

PNW region is well suited for use of assisted migration during reforestation

- Many dominant commercial species are specialists with narrow climatic niches
- Planting is commonly used during reforestation following disturbance
- The region has a lot of disturbance



Species selection

Various tools based on species distribution modeling



Tremendous uncertainty on utility

Higher risk associated with species movement far beyond its range (pathogens, maladaptation, etc)

The screenshot shows the 'Species Potential Habitat Tool' interface. The browser address bar displays 'specieshabitattool.org/sph/'. The tool has three tabs: 'About', 'Tool', and 'Advanced'. The 'Tool' tab is active, showing four main steps:

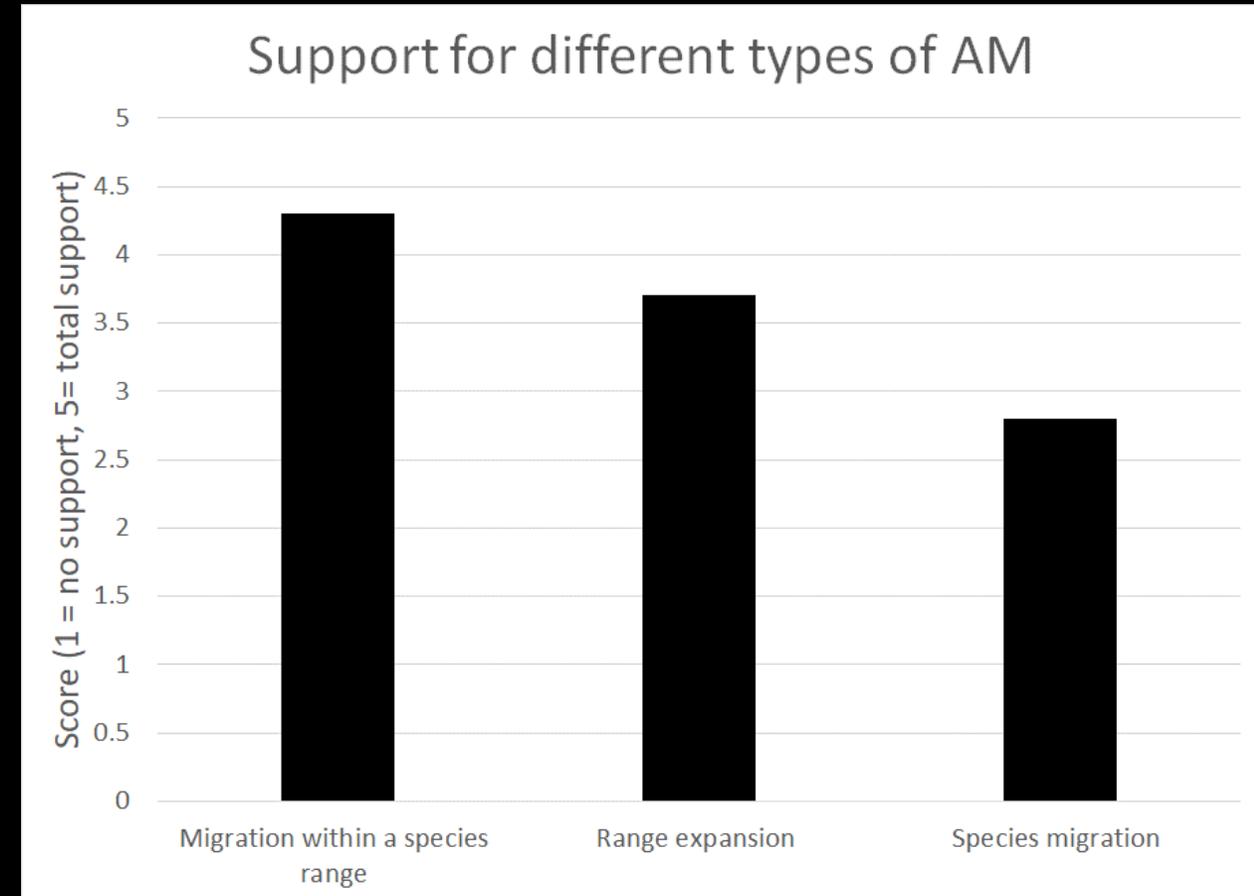
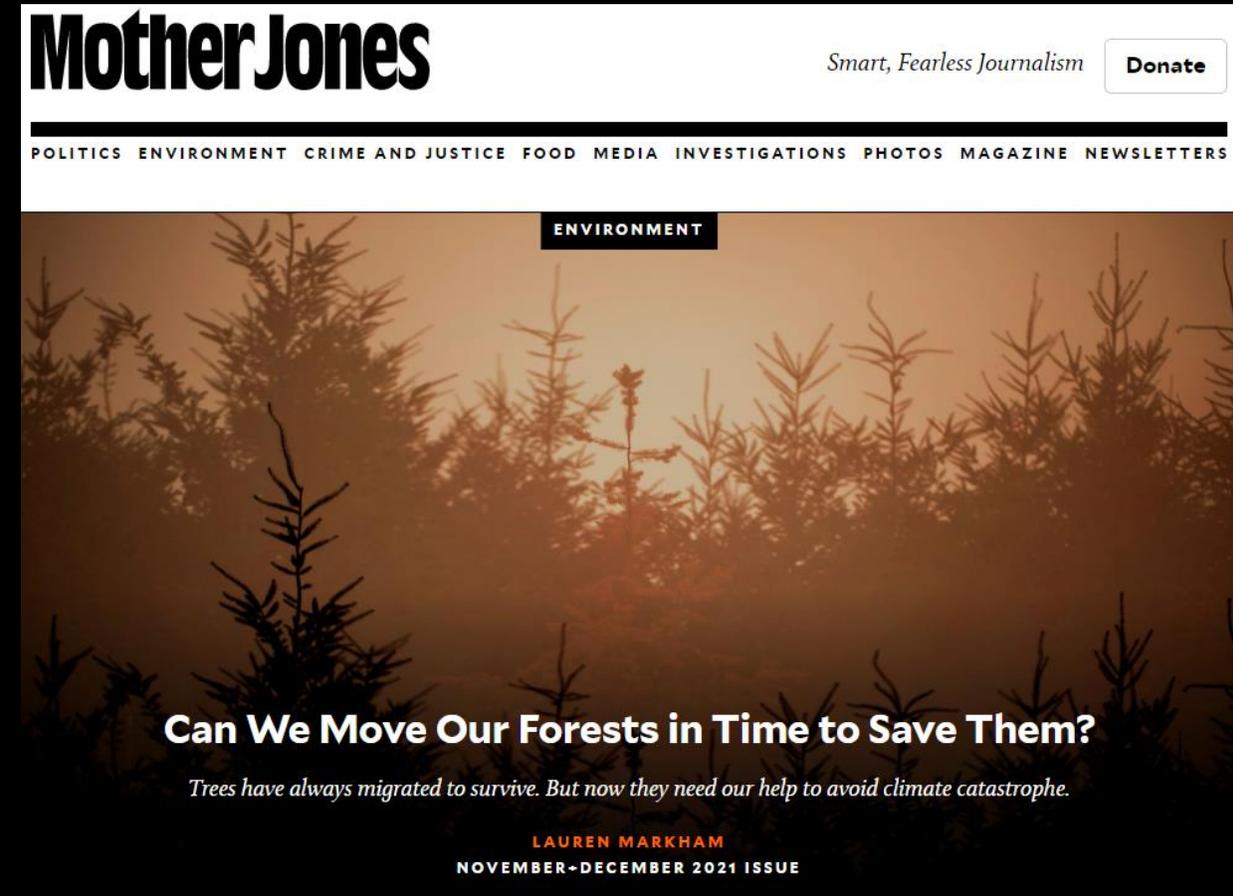
- 1 Select Species**: A dropdown menu shows 'Ponderosa pine'.
- 2 Select Species Distribution Record**: A dropdown menu shows '1981 - 2010'.
- 3 Select Modeling Conditions**: A table for selecting a future time range and a model.

	RCP 4.5	RCP 8.5
2011 - 2040	<input type="checkbox"/>	<input type="checkbox"/>
2041 - 2070	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2071 - 2100	<input type="checkbox"/>	<input type="checkbox"/>
- 4 Download**: A button labeled 'Download'.

The right side of the interface features a map of the Pacific Northwest region of North America, showing the potential habitat distribution for the selected species. The map is color-coded, with green and yellow indicating suitable habitat. Major cities like Vancouver, Seattle, Portland, and San Francisco are labeled. The map also shows state and provincial boundaries.

Species Potential Habitat Tool: <https://specieshabitattool.org/sph/>

Broader support in using assisted population migration (APM) to increase future resilience



Survey of R6 forest managers (n=52)

5 = total support, 0 = no support

Challenges to operational implementation

- Uncertainty on how far is too far to move in climate space
- Getting the trees to survive until climate change aligns with their population niche
- Hesitation at doing something new
- Barriers – logistical, policy, and administrative



Experimental Network for Assisted Migration and Establishment Silviculture (ENAMES)

Overarching objective: provide information on what seed sources to plant and the establishment practices needed for reforestation success

- Multidisciplinary
- Multiownership
- Coproduction with practitioners

Designed to be directly relevant to operational application



WASHINGTON STATE DEPT OF
**NATURAL
RESOURCES**



Experimental design: Assisted migration

Common treatments across sites

Seedlot Selection Tool to ID seed sources



Four climate-associated genotypes

- Historic climate / seed zone
- Current climate (+1 °C)
- Mid century climate (+2 °C)
- End of century (+4 °C)

Experimental design: Silviculture practices

Variable treatments across sites
dependent on partner interest

- relevant to their objectives
- specific information need

Practices to date:

- stock type
- competition control
- planting density
- slash management



Implementation status

Partners: NFS, BLM, ODF, WA DNR

Primarily Douglas-fir and Ponderosa pine

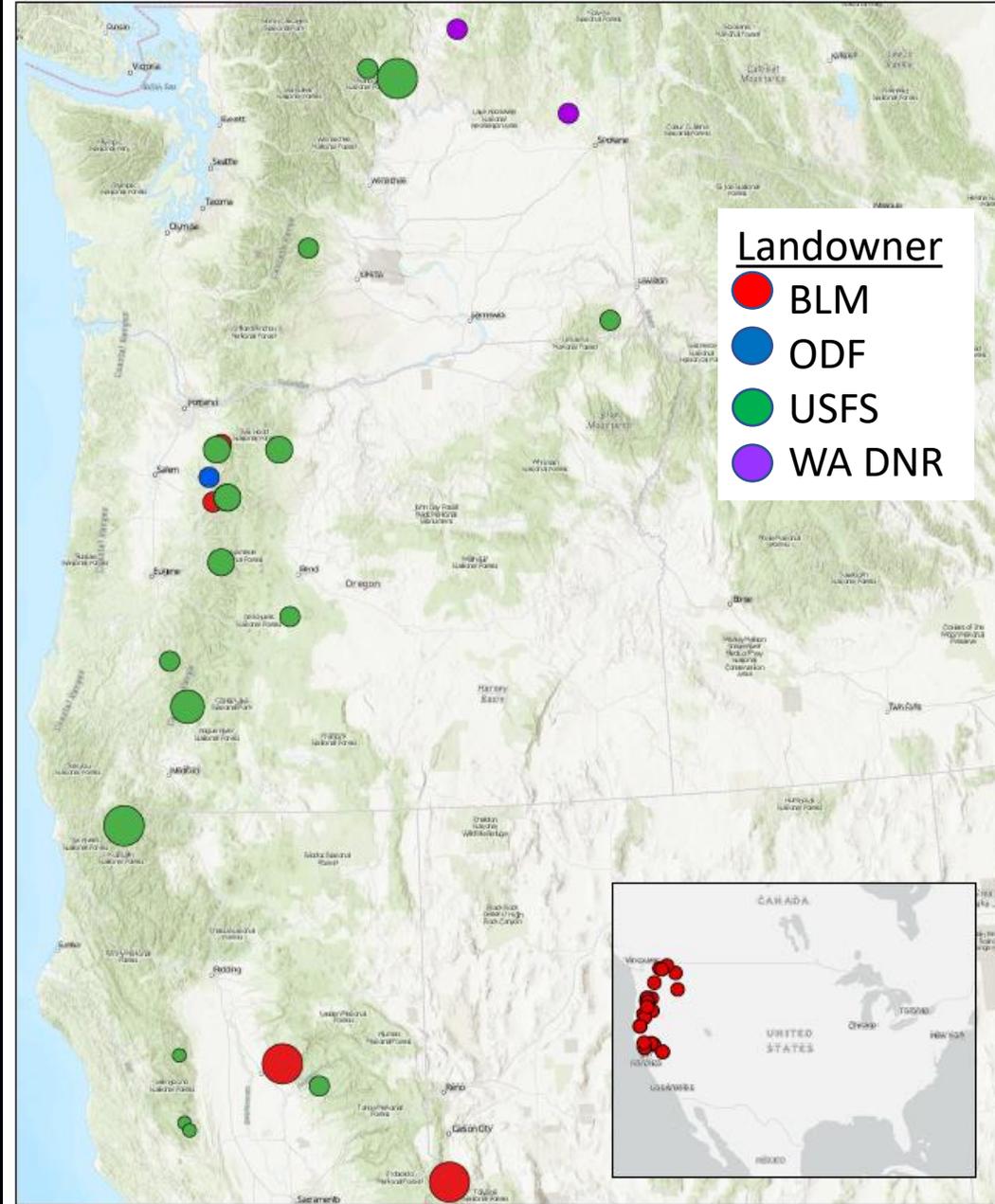
- 2 sites planted 2021 (1 yr response)
- 5 sites just planted
- 14 sites in Spring 2024
- 5-10 sites in Spring 2025

Discussions with new partners (tribal, DoD, industry)



Experimental Network for Assisted Migration and Establishment Silviculture site locations

0 25 50 100 150 200 Miles NAD 83 - UTMN 10



Science engagement

Engagement with stakeholders and the public is a core objective

Much of the information generated from this project will be disseminated via our website

Also: newsletters, video testimonials, webinars, and others

Pacific Northwest Research Station

Home Research Products News About People

Experimental Network for Assisted Migration and Establishment Silviculture (ENAMES)

Status: Action Dates: July 2022

The USDA Forest Service Pacific Northwest and Pacific Southwest Research Stations have initiated a study to learn how we can improve the success of reforestation activities across the western United States through novel silvicultural practices, including human-assisted migration of seed sources to more hospitable environs.

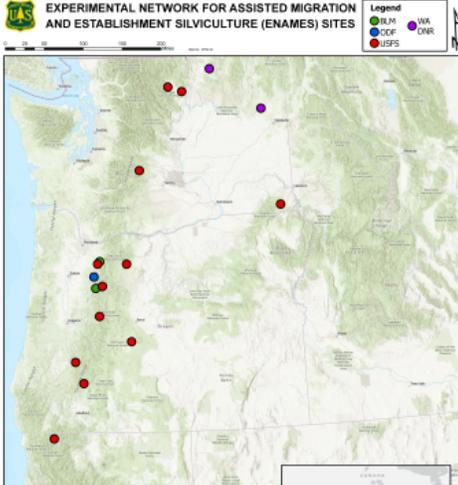
Our goal for this project is to evaluate the selection of seed sources and post-disturbance stand establishment practices to provide guidance on **what tree seed sources to use and how to plant them** to maintain functional forest ecosystems in the future.

Overview **Research** People Resources

Methods

To determine which seed sources to plant at a given site and how to plant them, we have initiated a experimental network focused on assessing the effect of assisted population migration and silvicultural practices on the short- and long-term success of reforestation activities. Specifically, we are undertaking the following:

- Establishing a new network of 25+ experimental sites across California, Oregon, and Washington through collaboration between researchers and land managers. We plan to have most sites installed by spring 2024.
- Testing the effect of assisted population migration in partnership with forest managers across all ownerships. Assisted migration treatments at each site will include seed sources representing four different climate scenarios (recent-past, current, mid-century, and end-of-century climates).
- Testing different silvicultural strategies designed to increase reforestation success and long-term forest resilience. Each treatment will be crossed with three silvicultural treatments that represent adaptation strategies.



<https://www.fs.usda.gov/research/pnw/projects/enames#research>

Operational relevance

ENAMES designed with application as a key consideration

- Partner-driven information needs
- Operational implementation
- Easily-interpreted assessments



Moving forward



- Urgent need for management actions to initiate adaptation to future climate
- APM is a conceptually robust, low-risk approach that can be readily implemented during reforestation
- Transfer distances are still being refined, but “small” changes can be made now to help maintain the forests for tomorrow

ENAMES team and contributors

PNW Station

Rob Slesak – Research Forester

Brad St Clair – Research Geneticist

Rich Cronn – Research Geneticist

Leslie Brodie – Forester

James Dollins – Forester

Michelle Agne – ORISE Postdoc

Laura Gonzalez Mantecon – ORISE Fellow

Others

20+ Forest managers / silviculturists

Dorena Genetic Resource Center

J. Herbert Stone Nursery

Placerville Nursery

Webster Nursery – WA DNR

PSW Station

Jessica Wright – Research Geneticist

Chris Looney – Research Forester

NFS R6

Vicky Erickson – Regional Geneticist

Erin Baumgart – Area Geneticist

Andy Bower – former Area Geneticist

Claire Ellwanger – Area Geneticist

Matt Horning – Area Geneticist

Scott Kolpak – Area Geneticist

Robyn Darbyshire – Regional Silviculturist

NFS R5

Joe Sherlock – Regional Silviculturist

Questions?

robert.slesak@usda.gov

